10/002,399

REMARKS

Reconsideration of this application is respectfully requested. Claims 42-45, 61, and 74 have been rewritten in independent form. Applicants respectfully submit that claims 42-45, 61, and 74 have not been amended for reasons substantially related to patentability and have not been narrowed. Claims 1-93 are pending. Because claims 1-41, 46-60, 62-73, and 75-84 have been withdrawn from consideration, only claims 42-45, 61, 74, and 85-~~94~~ 93 are at issue.

Claims 42-45, 61, and 74 have been objected to for depending from non-elected claims. Claims 42-45, 61, and 74 have been rewritten in independent form. Accordingly, applicants respectfully request withdrawal of this objection.

Claims 88-92 have been rejected under 35 U.S.C. §112, second paragraph, as indefinite. The terms "total crystallinity" and "Rx" are allegedly vague. The term "total crystallinity" or degree of crystallinity (Xc) is well known in the art, and may be determined by known methods such as those described at page 17, line 30, to page 18, line 7, of the specification. The term "Rx" refers to reflectance, which is defined in the G. A. Smook, Handbook of Pulp & Paper Technology (p. 232) (Exhibit 1), as the ratio of the intensity of the light reflected by a paper test specimen to the intesity of light reflected by a perfectly reflecting, perfectly diffusing surface. The Rx value of a sample may be determined by known methods such as those described at page 18, lines 8-16, of the specification.

Rejection over Omiya

Claims 42-45 have been rejected under 35 U.S.C. §102(b) as anticipated by Omiya (U.S. Patent No. 4,508,894).

The Present Invention

A brief review of the chemistry and properties of cellulose and cellulose derivatives will put the invention in perspective and show how it is distinguishable from the prior art cited in the rejection. Mercerization is the swelling action of concentrated alkali, usually sodium hydroxide, on cellulose. Since cellulose is not soluble in water, the reaction is conducted as a heterogeneous reaction upon an aqueous slurry of cellulose fibers in water. The complete range of temperature and concentration conditions for mercerization with sodium hydroxide have been exhaustively studied by X-ray methods on mercerized and recovered cellulose. See Cellulose and Cellulose Derivatives, Volume V of HIGH POLYMERS, edited by Emil Ott, pages 272-345 on Mercerization, Interscience Publisher, Inc., New York, NY, 1943 (Exhibit 2). See especially, Ott at 273-274.

Very interesting is a description of changes to the microscopic structure of cellulose fibers. In a section of Ott starting at page 338 written by E. I. Valko more than fifty years ago, the changes to cotton fiber were described as follows:

> Immediately before the ripe boll burst open and exposes its flocks of cotton to the atmosphere, the fibers are tubular, with the hollow center (the "lumen") occupying a considerable portion of the cross section. No convolutions or twists are present, and the cross sections approach very closely to an elliptical or even circular form. On exposure to the air, the fiber dries out quickly and collapses to form a flat, convoluted ribbon. Commercial cotton hair is in this form.
>
> When the cotton hair is brought into mercerizing solution, it begins to swell at once. In a few seconds it become elliptical, and, on further swelling, the cross section becomes almost circular. The diameter of this section is at least 25 to 30% greater than the width of the collapsed fiber.[33] . . . . During the mercerization process, the cellulose of the walls swells inwardly. After the alkali treatment and during the washing and drying, the cross section shrinks. During this shrinkage, the hair retains the same circular form, but the shrinkage proceeds uniformly toward the axis and the lumen does not recover its original size. . . . . By the strong

> swelling, the arrangement which was responsible for the collapse of the native hair is broken up, and the cylindrical form is retained upon subsequent drying.

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[33] M. A. Calvert and F. Summers, *J. Textile Inst.*, 16 T233 (1925).

Although many of the literature discussions of mercerization talk of it as being the treatment with alkali, it must be noted that physical studies of the effects of mercerization have all been performed on cellulose, which, after treatment with alkali, has been washed and dried. Washing removes the alkali. More recent discussions talk in terms of an irreversible change from native, amorphous cellulose I to cellulose II or crystalline cellulose.

Sarko et al. (Exhibit 3) have studied the conversion of the crystal structure of native cellulose (cellulose I) to that of cellulose II through a series of crystalline intermediate alkali cellulose complexes. See Crystalline Alkali-Cellulose Complexes as Intermediates During Mercerization by Sarko et al, page 169-177 written as Chapter 9 of <u>The Structures of Cellulose</u>, Rajai H. Atalla, Editor, ACS Symposium Series Volume 340, American Chemical Society, Washington, DC, 1987. "Removing the NaOH [i.e., alkali] from the structure through washing with water removes the energy-lowering electrostatic field. This results in a conversion of the structure to the only energy-lowering one that is available to it – a twofold helical, interchain hydrogen-bonded sheet structure." Sarko at page 176. While treatment with alkali to produce an alkali cellulose occurs in mercerization, it is the washing to remove the alkali which produces the final irreversible transformation to cellulose II.

> "Mercerization is the name given to the conversion accomplished by swelling native cellulose fibres in concentrated sodium hydroxide solution. Although no dissolution occurs, the swelling allows for reorganization of the chains, and cellulose II results when the swelling agent is removed." Kolpak et al., *Polymer*, 19:123-131, 123 (Feb. 1978) (Exhibit 4).

In the derivatization process to form a cellulose ether such as carboxymethyl cellulose (CMC) or methyl cellulose, the first step is the formation of an alkali cellulose, a heterogeneous reaction performed on a slurry of the starting cellulose. This is followed by derivatization (sometimes referred to as alkylation or etherification) of the cellulose, at which point it may dissolve. Derivatization performed on an alkali cellulose produced from **native cellulose (cellulose I)** is described many times in the cited references used to reject the instant claims. However, that alkali cellulose does not contain cellulose II.

In contrast, the cellulose ethers of this invention is produced by derivatization of **cellulose II**, which has been produced by mercerization and recovery of the pulp prior to formation of an alkali cellulose in the derivatization process. Therefore, the prior art processes are not the same as the claimed process, and, as the data cited below from the written description shows, the cellulose ethers of the present invention are not the same as the prior art cellulose ethers.

Omiya does not disclose or suggest preparing CMC from cellulose II (i.e., previously mercerized and recovered cellulose) as in the presently claimed invention.

Tables 1-4 below show the viscosity of CMC's prepared as described in Examples 1-5, 7, 9, and 10 of the present application from various starting cellulose pulps, including never-dried and re-wetted cellulose pulps which had been converted from cellulose I to cellulose II by mercerization and recovery. The control for each example was prepared by the same procedure as the example on the native cellulose (cellulose I) which was not mercerized and recovered before being alkalated and etherified, i.e., generally prepared by the procedure described in Wüst.

Table 1

CMC Derived from Cotton Linter Pulp				
Example No. in the present application	Concentration of NaOH (%)	1% Solution Viscosity (cP)	Control's 1% Solution Viscosity (cP)	Percentage Change in Viscosity
1 (Never-dried)[1]	14	80095	34690	130.89%
	18	83745	34690	141.41%
7 (Never-dried)	18 (Average)	79410	21493	269.47%
7 (Re-wetted dried)	18 (Average)	43453	21493	102.17%
9 (Never-dried)	18	75190	30145	149.43%
10 (Never-dried)	18	55335	25685	115.44%
10 (Never-dried)	18	57190	13920	310.85%

Table 2

CMC derived from Southern Softwood Kraft Pulp				
Example No. in the present application	Concentration of NaOH (%)	1% Solution Viscosity (cP)	Control's 1% Solution Viscosity (cP)	Percentage Change in Viscosity
2[2]	10	607	586	3.58%
	14	1268	586	116.38%
	18	1147	586	95.73%
3 (Never-dried)	7	679	550	23.45%
	10	1108	550	101.45%
	14	1365	550	148.18%
	18	1472	550	167.64%

[1] The 7 and 10% NaOH treated pulp contained 0% sheet cellulose II and, therefore, was not mercerized.

[2] Table 2 indicates that the 7% NaOH treated pulp contained 0% sheet cellulose II and, therefore, was not mercerized..

Table 3

CMC derived from Southern Hardwood Kraft Pulp				
Example No. in the present application	Concentration of NaOH (%)	1% Solution Viscosity (cP)	Control's 1% Solution Viscosity (cP)	Percentage Change in Viscosity
5[3]	10	461	230 or 362	100.43% or 27.35%
	14	547	230 or 362	137.83% or 51.10%
	18	923	230 or 362	301.30% or 154.97%

Table 4

CMC derived from Northern Softwood Sulfite Pulp				
Example No. in the present application	Concentration of NaOH (%)	1% Solution Viscosity (cP)	Control's 1% Solution Viscosity (cP)	Percentage Change in Viscosity
4[4]	10	2037	898 or 1087	126.84% or 87.40%
	14	1835	898 or 1087	104.34% or 68.81%
	18	2608	898 or 1087	190.42% or 139.93%

Tables 1-4 show that CMC's produced by the process of the present invention have significantly higher viscosities than CMC's produced by prior art processes. For example, Table 1 shows that when a cotton linter pulp starting material is mercerized and recovered prior to alkalating and etherifying, the viscosity of the CMC formed increases by at least 102%. Table 4 shows that when a sulfite pulp starting material is mercerized and recovered prior to alkalating and etherifying, the viscosity of the CMC formed increases by at least 104%.

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3 Table 6 indicates that the 7% treated pulp contained only 1% sheet cellulose II.

4 Table 5 indicates that the 7% treated pulp contained 0% sheet cellulose II and, therefore, was not mercerized.

Since the presently claimed CMC's can have significantly higher viscosities than prior art CMC's such as that disclosed in Omiya, applicants respectfully submit that they are different than prior art CMC's, and the CMC's of this invention are not anticipated by Omiya. *In re Marosi*, 218 USPQ 289 (Fed. Cir. 1983).

Rejection over Moore

Claims 61 and 74 have been rejected under 35 U.S.C. §102(b) as anticipated by Morse (U.S. Patent No. 4,269,859). Morse discloses cellulose floc granules and a process for preparing the same (see, e.g., cols. 6 and 7).

The cellulose in Morse's cellulose floc has not previously been treated with alkali and recovered. Accordingly, it is cellulose I. In contrast, the cellulose floc of the present invention is cellulose II. As discussed above, cellulose I and cellulose II are different.

Furthermore, the cellulose floc produced by the presently claimed method can be used to produce cellulose ethers having significantly higher viscosities (as shown above) than those produced with the cellulose floc containing cellulose I, such as that in Moore.

For the foregoing reasons, Moore does not anticipate claims 61 and 74 and applicants respectfully request withdrawal of this rejection.

Rejection over Edelman

Claims 85-93 have been rejected under 35 U.S.C. §103(a) as obvious over Edelman (U.S. Patent No. 4,941,943). Edelman disclose a method for preparing CMC. The Examiner asserts that it would have been obvious to select mercerized and recovered cellulose pulp to produce sodium CMC as taught by Edelman, because Edelman had disclosed "the

mercerization of cellulose to achieve accessibility and homogeneity before the cellulose is activated with NaOH to produce [CMC]" (col. 1, lines 11-20).

Contrary to the Examiner's assertion, Edelman does not disclose or suggest mercerizing and <u>recovering</u> cellulose before converting it into CMC. At col. 1, lines 11-30, Edelman discusses the benefits of mechanically treating cellulose mixed with alkali before "the etherification itself":

> As a result of the pretreatment, i.e., the mercerization, alkali cellulose is produced, which forms NaCMC together with the etherification reagent.

(col. 1, lines 17-20).

Edelman does not disclose or suggest CMC ~~derived from cellulose~~ having at least about 20% by weight of cellulose II. The CMC in Edelman is derived from cellulose which has not been mercerized *and recovered*. Therefore, the cellulose used to prepare the CMC in Edelman is cellulose I, not cellulose II. As discussed above, CMC derived from cellulose I has significantly different properties than that derived from cellulose II. Accordingly, Edelman does not render obvious claims 85-87.

Edelman also does not disclose or suggest CMC derived from cellulose having an Rx value of greater than 0.57. Cellulose I has an Rx value less than 0.57. Since the cellulose to prepare the CMC in Edelman is cellulose I, it has an Rx value less than 0.57. Accordingly, Edelman does not render obvious claims 88-90.

Cellulose I also does not have a total crystallinity of less than about 60% or a moisture content less than 20%. Therefore, Edelman does not render obvious claims 91-93.

In view of the above remarks, it is respectfully requested that the application be reconsidered and that all pending claims be allowed and the case passed to issue.

If there are any other issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

Respectfully submitted

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